



Army Developmental  
Test Command



Air Force Flight  
Test Center

# ***Joint Distributed System-of-Systems Simulation (JDS<sup>3</sup>)***



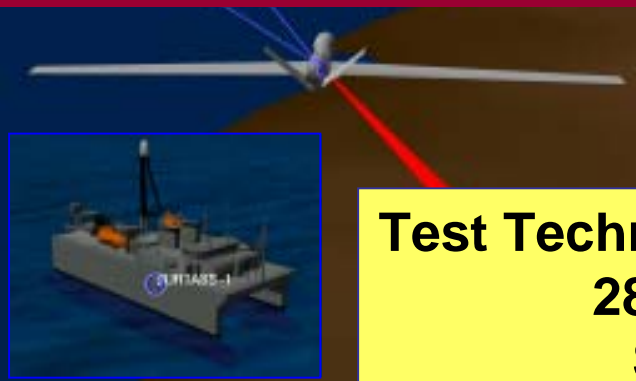
Army CERDEC



***SPAWAR  
Systems Center  
San Diego***

**J. Michael Barton**  
Army Developmental Test Command  
Aberdeen Proving Ground, MD

**Robert A. Pritchard**  
SPAWAR Systems Center – San Diego  
San Diego, CA



**Test Technology Symposium 2004**  
**28 – 29 April 2004**  
**San Diego, CA**



# ***High Performance Computing Modernization Program***

## **HPCMP**

OSD effort begun in 1992 to provide DOD scientists access to State-of-the-art computing resources & training, and keep the industrial base competitive.

**Consists of 3 Facets:**

### **Hardware**

**Major Shared Resource Centers (MSRCs)**

**Distributed Centers (DCs)**

### **Network (DREN/SDREN)**

### **Software Applications Support**

- **Common HPC Software Support Initiative (CHSSI)**
- **Programming Environment and Training (PET)**

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# ***HPCMP***

## **Call for HPC Software Applications Institute (HSAI) Proposals**

<b>CFP:</b>	<b>Part of CHSSI</b>
<b>Issued:</b>	<b>Nov 2004</b>
<b>Submissions:</b>	<b>4 Proposals Per Service and 2 Per Agency Allowed</b>
<b>Proposals Due:</b>	<b>10 Mar 2004 (Submitted)</b>
<b>Awards:</b>	<b>5 to 8</b>
<b>Selection:</b>	<b>May 2004</b>
<b>Funding:</b>	<b>July 2004 (Partial for FY04) \$0.5 - 3M Per Award per Fiscal Year 6 Years</b>

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# ***HPCMP HSAI***

## **Goals**

**Enhance existing service/agency high priority projects**

**Utilize current HPC technology**

**Eliminate software stovepipes**

**Leverage existing HPC activities in parent organization**

**Accelerate high impact areas; don't start from zero**

**Service managed**

**Mission focus**

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# ***JDS<sup>3</sup> Team***

## ***Army Lead with Navy, Army, and Air Force Principals***

- **Army Lead**: Dr. J. Michael Barton, Army Developmental Test Command (DTC), Aberdeen, MD  
**HPC System of Systems Simulation (SOS) Portfolio Lead**
- **Navy**: Robert. A. Pritchard, SPAWAR Systems Center, San Diego, CA  
**HPC SOS-02 Project Lead**
- **Army**: Dr. Barry Perlman, Communications-Electronics, Research, Development, and Engineering Center (CERDEC), Ft. Monmouth, NJ  
**HPC Electronic Battlefield Environment (EBE) Portfolio Lead**
- **Air Force**: Jenny M. Williams, Air Force Flight Test Center (AFFTC), Edwards AFB, CA  
**Modeling and Simulation Lead & Distributed Center Manager**

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# ***Shared Vision***

## **Interoperable System of Systems**

**Army Enterprise Architecture**



**Navy FORCEnet**



**See First**

**Act First**

**Understand First**



**Finish  
Decisively**

**Air Force C2 Constellation**

***Joint Distributed System-of-Systems Simulation (JDS<sup>3</sup>)***

# ***Joint Distributed System-of-Systems Simulation (JDS<sup>3</sup>)***

## **Goals**

**Support services to resolve complex system-of-systems NCW issues**

**Army Enterprise Architecture**

**Navy FORCEnet**

**Air Force C2 Constellation**

**Insure interoperability of joint NCW systems**

**Focus on communications and networks**

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# ***Communications***

## **Essential to the Battlespace**

**No C2 without communications**

**Sensor tasking and reporting**

**Target nomination, attack decision, weapons pairing**

**Attack orders and weapons control**

**Battle damage assessment**

**Force coordination**

**Force location via electronic navigation**

**GPS**

**TACAN**

**JTIDS relative navigation**

**Force identification (IFF)**

**Communications intelligence**

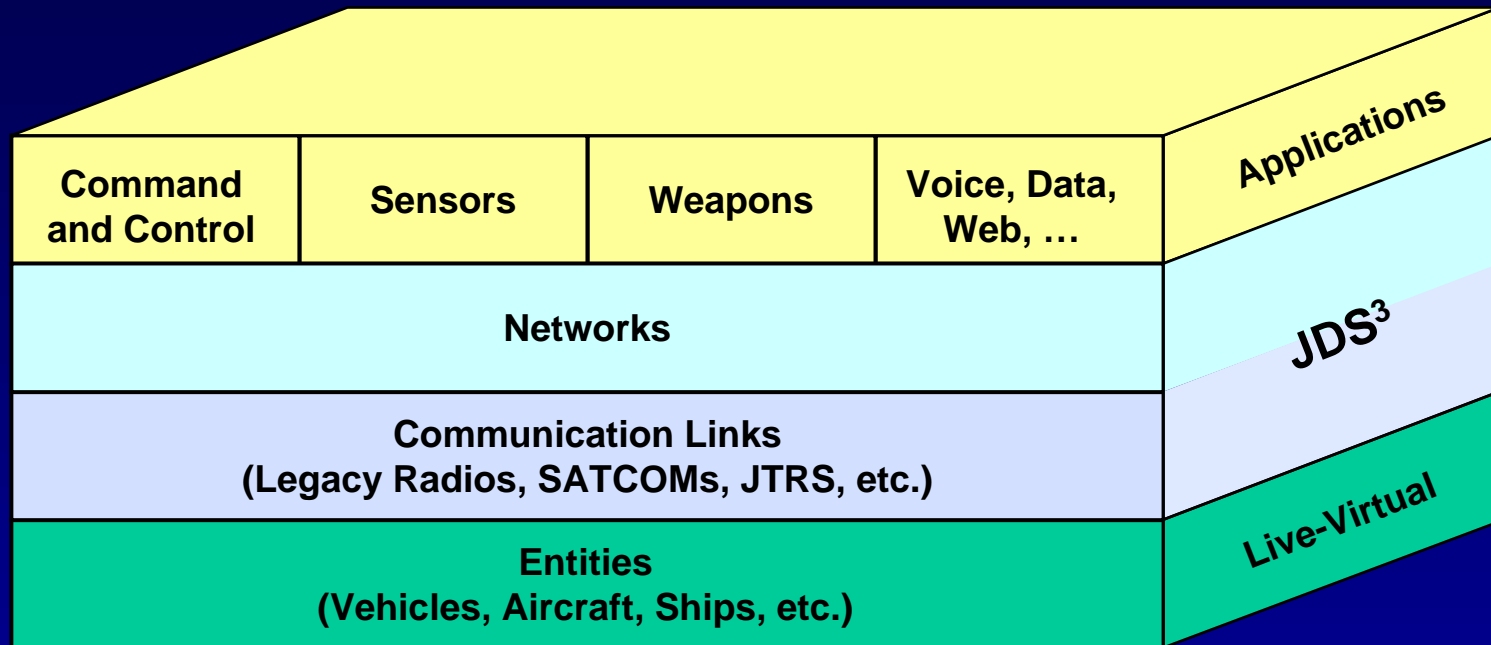
**Insure Friendly but Deny Enemy Communications**

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# ***JDS<sup>3</sup> Focus***

## **Communication and Network Layers**



**Provides virtual communication and network layers**

**Supports other systems (C4ISR, weapons, logistics, etc)**

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# Challenge

## Implementing the Networked Joint Force

**Fixed commercial networks:** difficult

Point-to-point, dedicated, hard-wired links

**Cellular networks:** more difficult

Dynamic entities joining and leaving cells; fixed, powerful cell tower; cell towers connected via land lines

**Battlefield:** extremely difficult

Dynamic entities joining and leaving cells

No powerful, interconnected, cell towers or fixed routers

Too much information, not enough bandwidth

Jamming and spoofing of communication links

High-priority time-critical information must get through

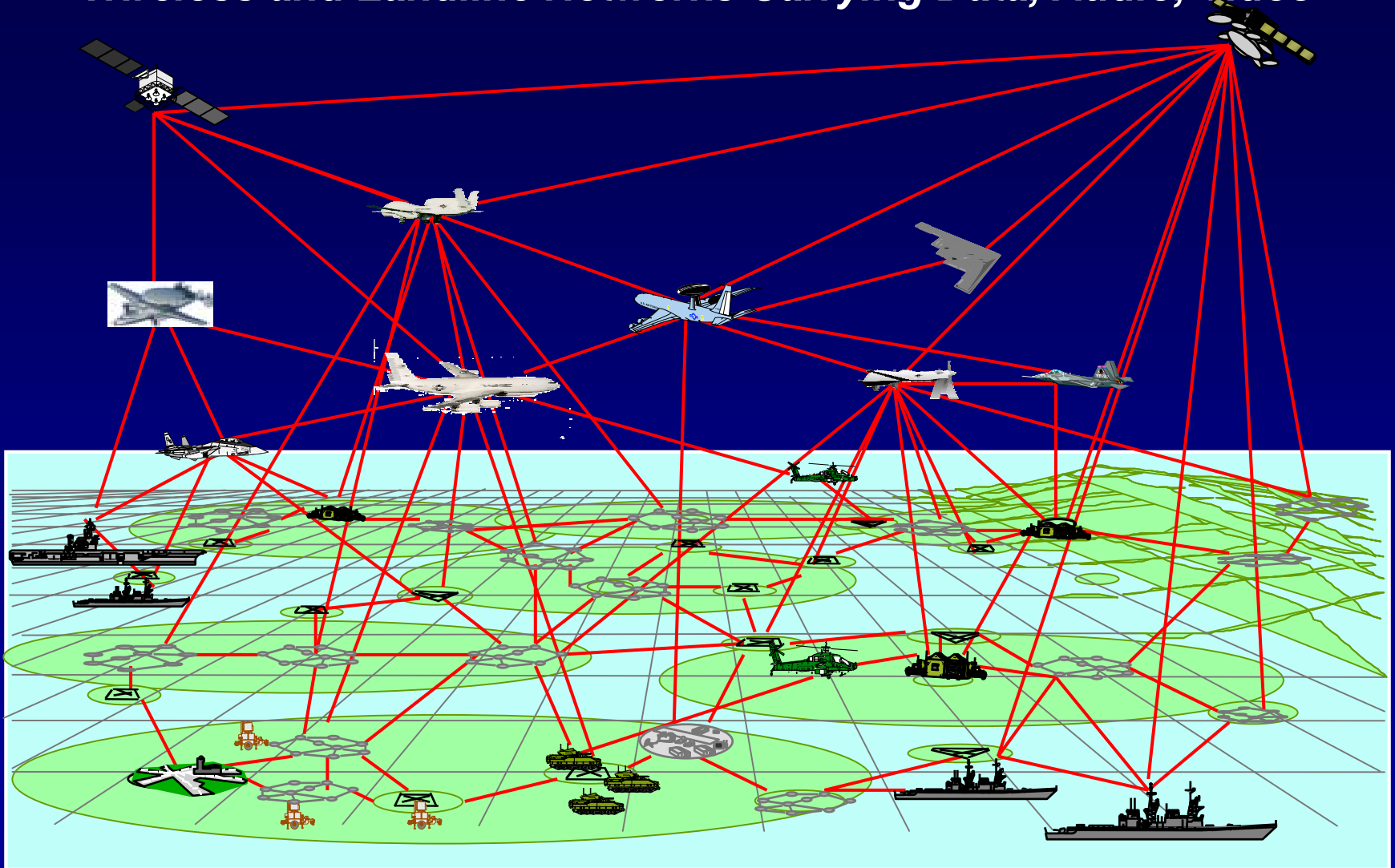
Forces operating in emission control modes

Scheduling, coordination, paths, com links, priorities, QoS ...

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# ***JTRS Mobile Ad Hoc Network Vision***

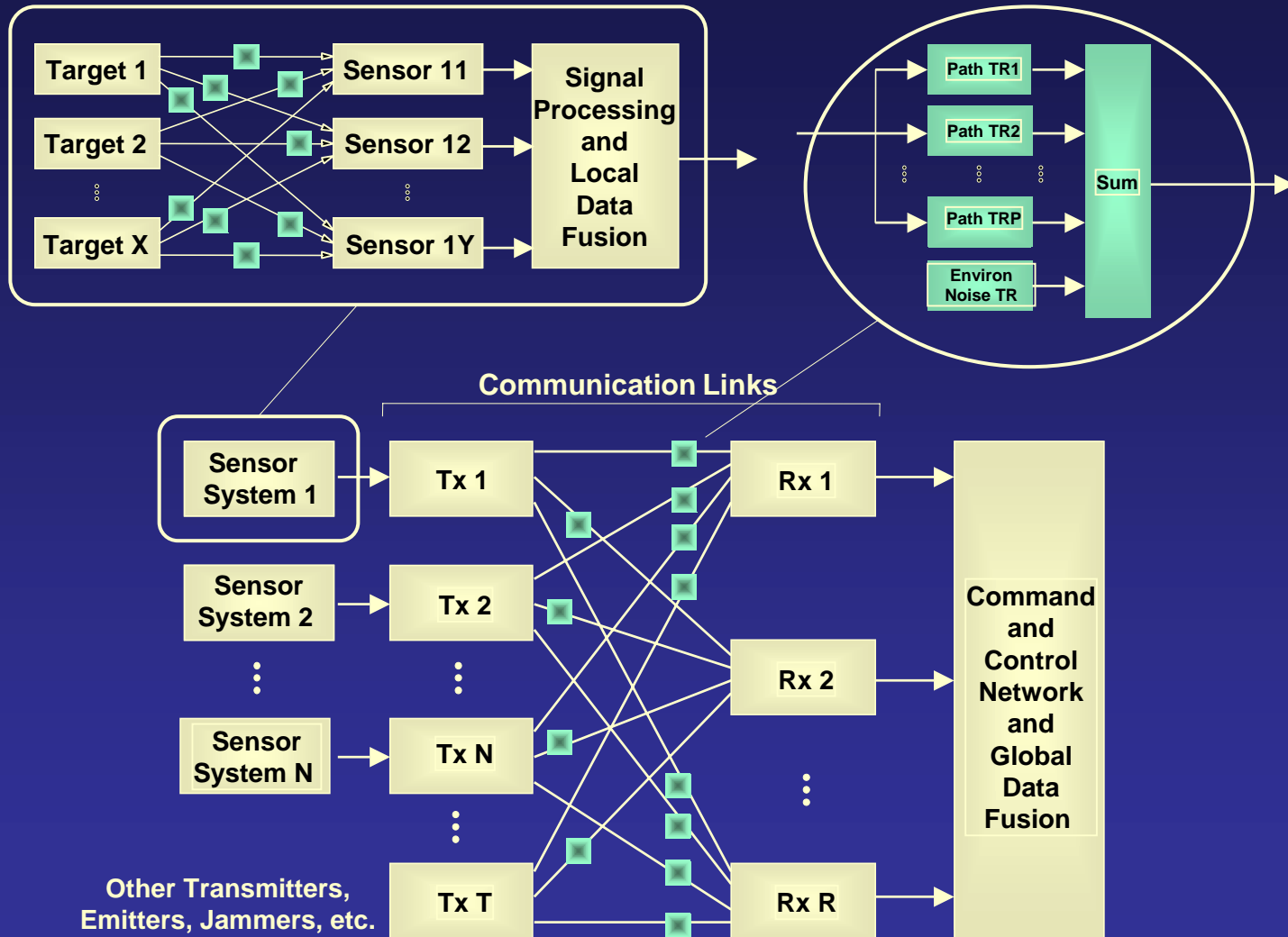
***Wireless and Landline Networks Carrying Data, Audio, Video***



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# Computational Challenge

## Sensor System of Systems



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# ***JDS<sup>3</sup>***

## ***Leverages and Integrates Existing HPC Capabilities***

### **HPCMP System-of-Systems Simulation (SOS) Portfolio**

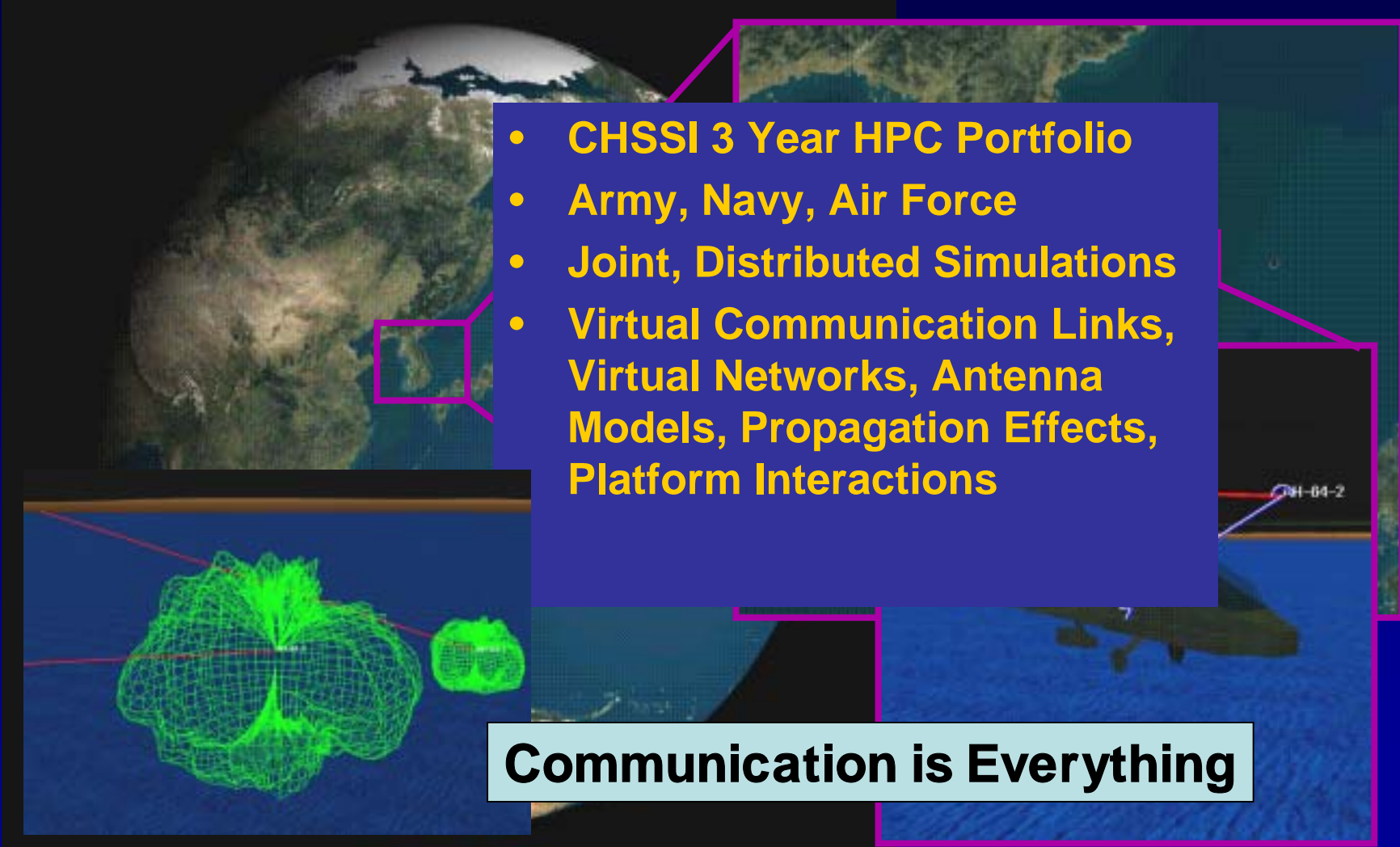
- Virtual Communication Links
- Network Models (DIEMS)

### **HPCMP Electronic Battlefield Environment (EBE) Portfolio**

- Antenna Models
- Propagation Models
- Network Models (QualNet)

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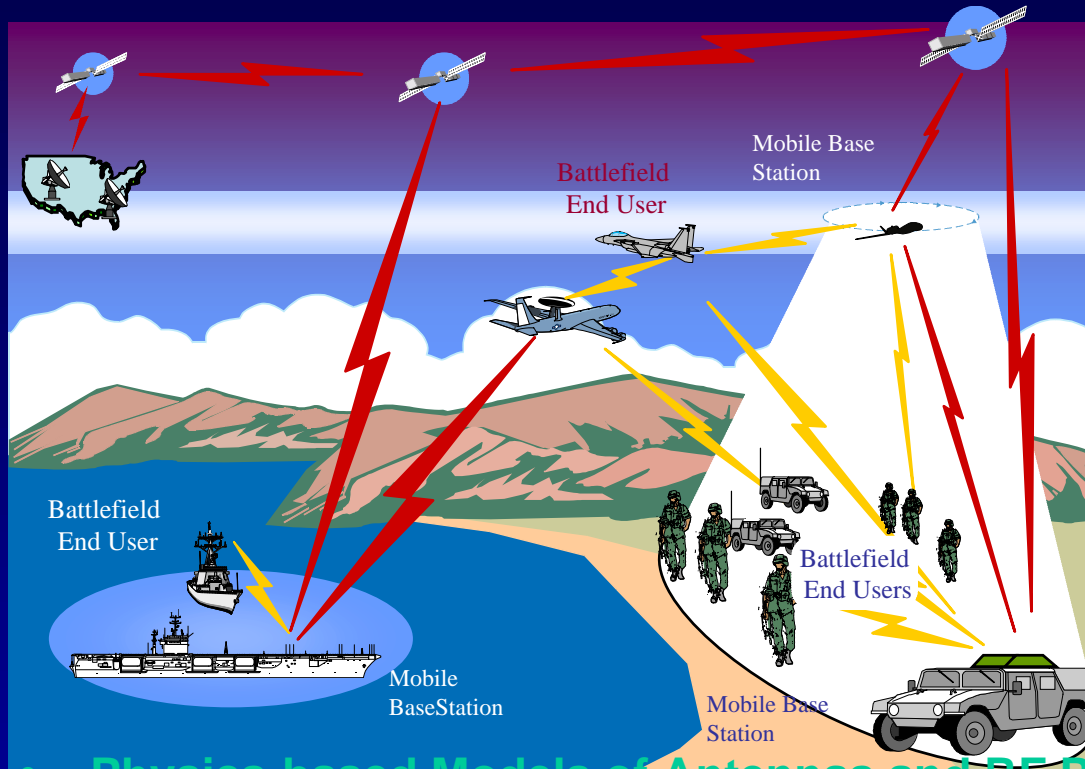
# ***System-of-Systems Simulation***

- 
- CHSSI 3 Year HPC Portfolio
  - Army, Navy, Air Force
  - Joint, Distributed Simulations
  - Virtual Communication Links, Virtual Networks, Antenna Models, Propagation Effects, Platform Interactions

**Communication is Everything**

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# *Electronic Battlefield Environment*



- CHSSI 5 Year HPC Portfolio
- Army, Navy, Air Force

- Physics-based Models of Antennas and RF Propagation
- Scalable Frequency-Domain Codes
- High Fidelity Analysis of Tactical Sensor and Communication Scenarios, and C4ISR System Performance Assessment

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# Virtual Components

## AN/ARC-164 UHF Radio



Java Virtual Components  
GUI



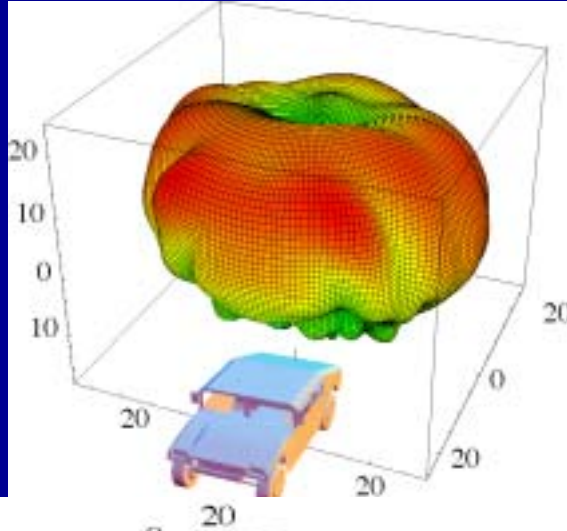
Real Radio

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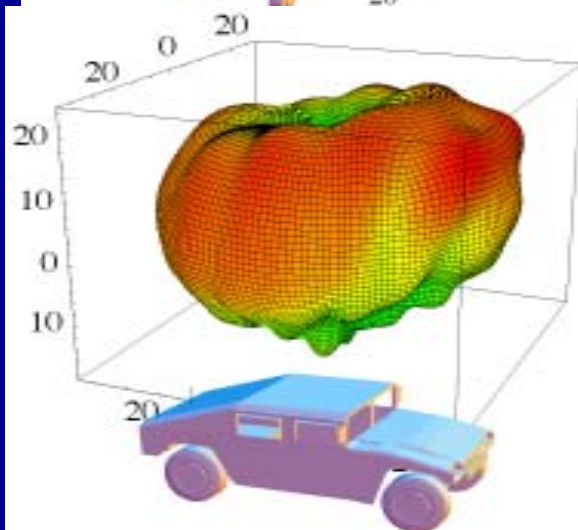


# Example Antenna Patterns

HMMWV, 250 MHz

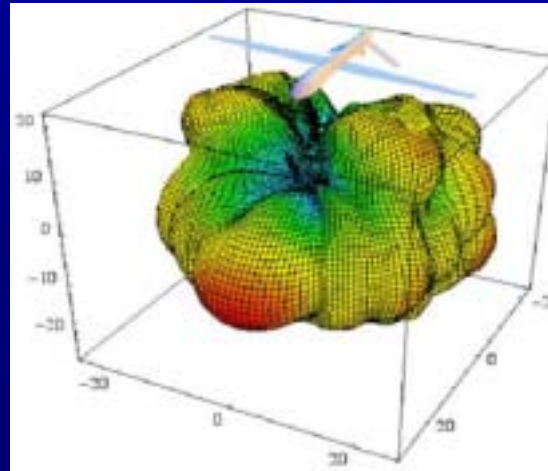


Front

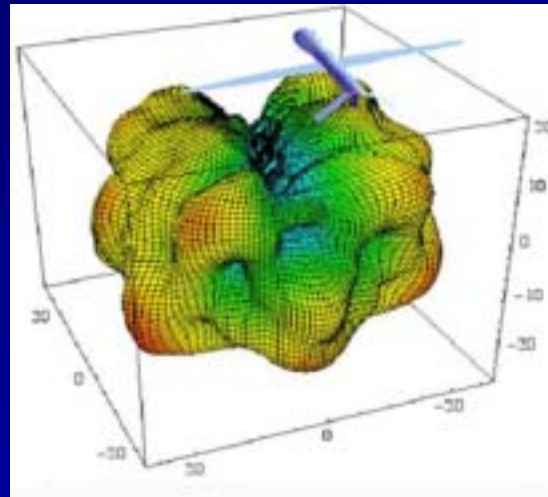


Side

Predator, 250 MHz bottom



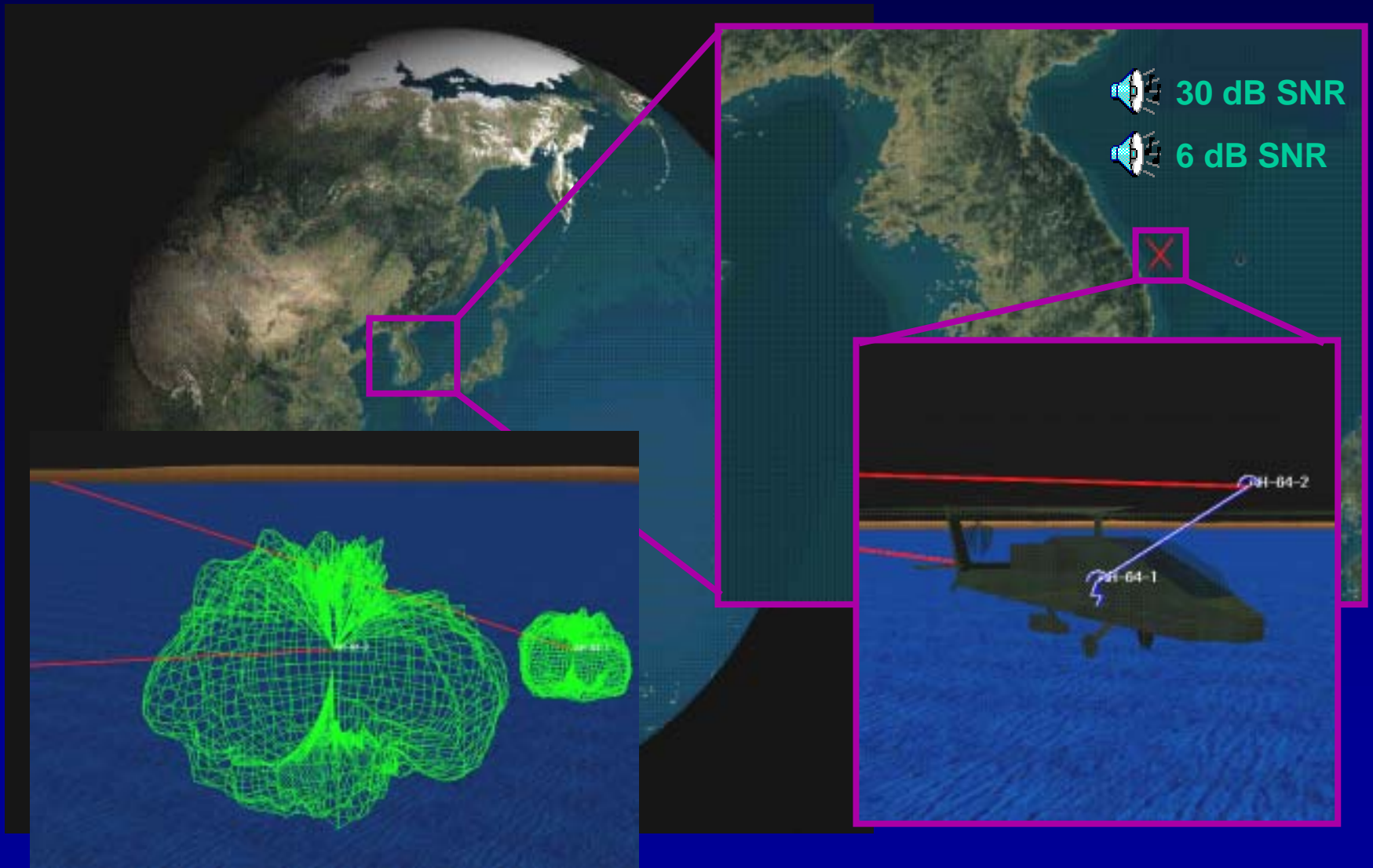
Front



Rear

**Notes:** Gains representative since antenna placement and type may be different from those on the actual platform.

# System-of-Systems Simulation



*Joint Distributed System-of-Systems Simulation (JDS³)*

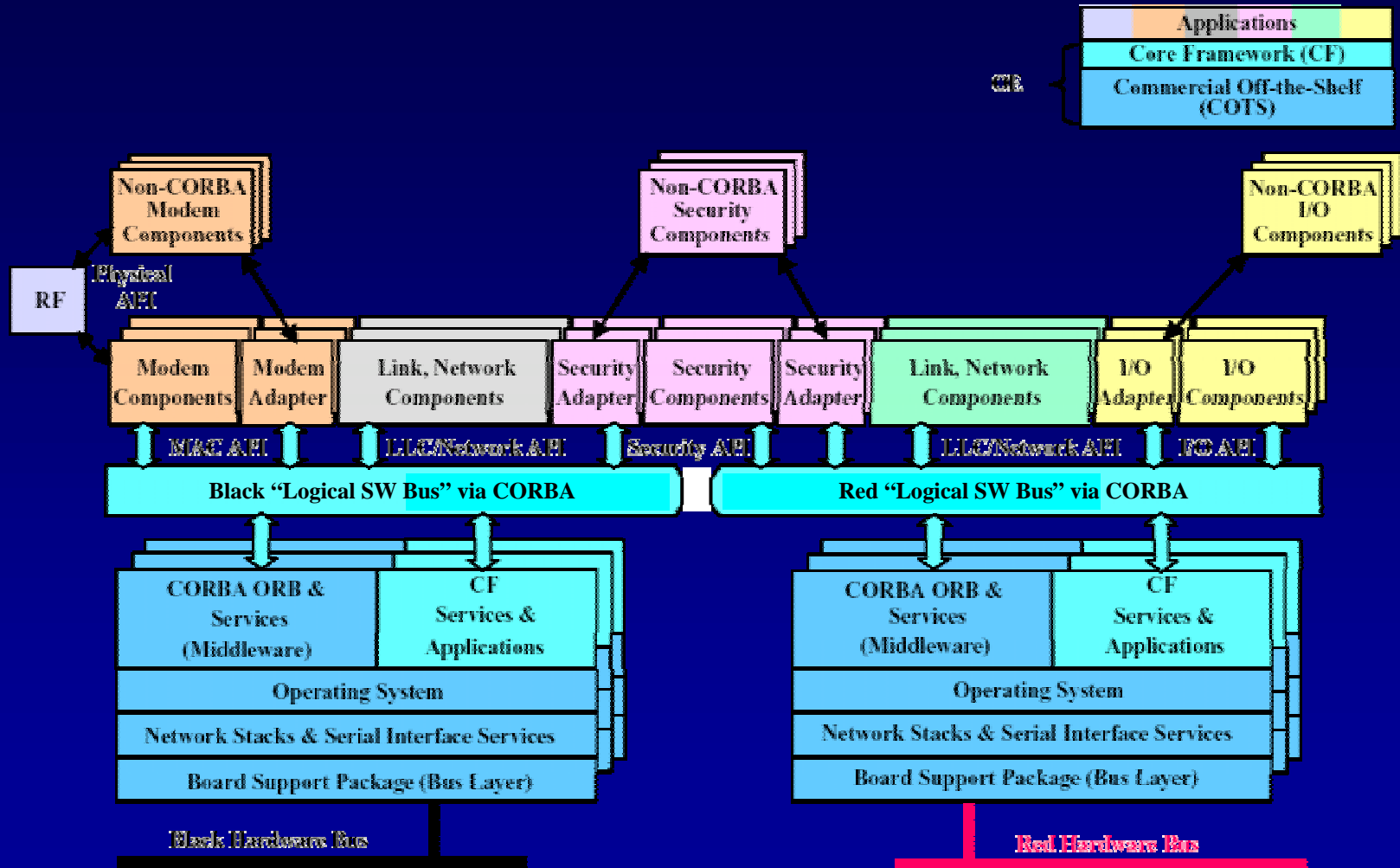
# *Joint Tactical Radio System*



- Army, Navy, Air Force, Marines, Coast Guard
- 17 Oct 03 Rock Drill conclusion
  - ATEC will test using IRCC
- DT, OT, Joint OT
  - FT-3, FT-5, LUT, MOT&E
  - DT: ATTC, Fort Huachuca
  - SBCT3 – First brigade equipped
-  **Joint Interoperability**

# JTRS

## Software Communications Architecture (SCA)

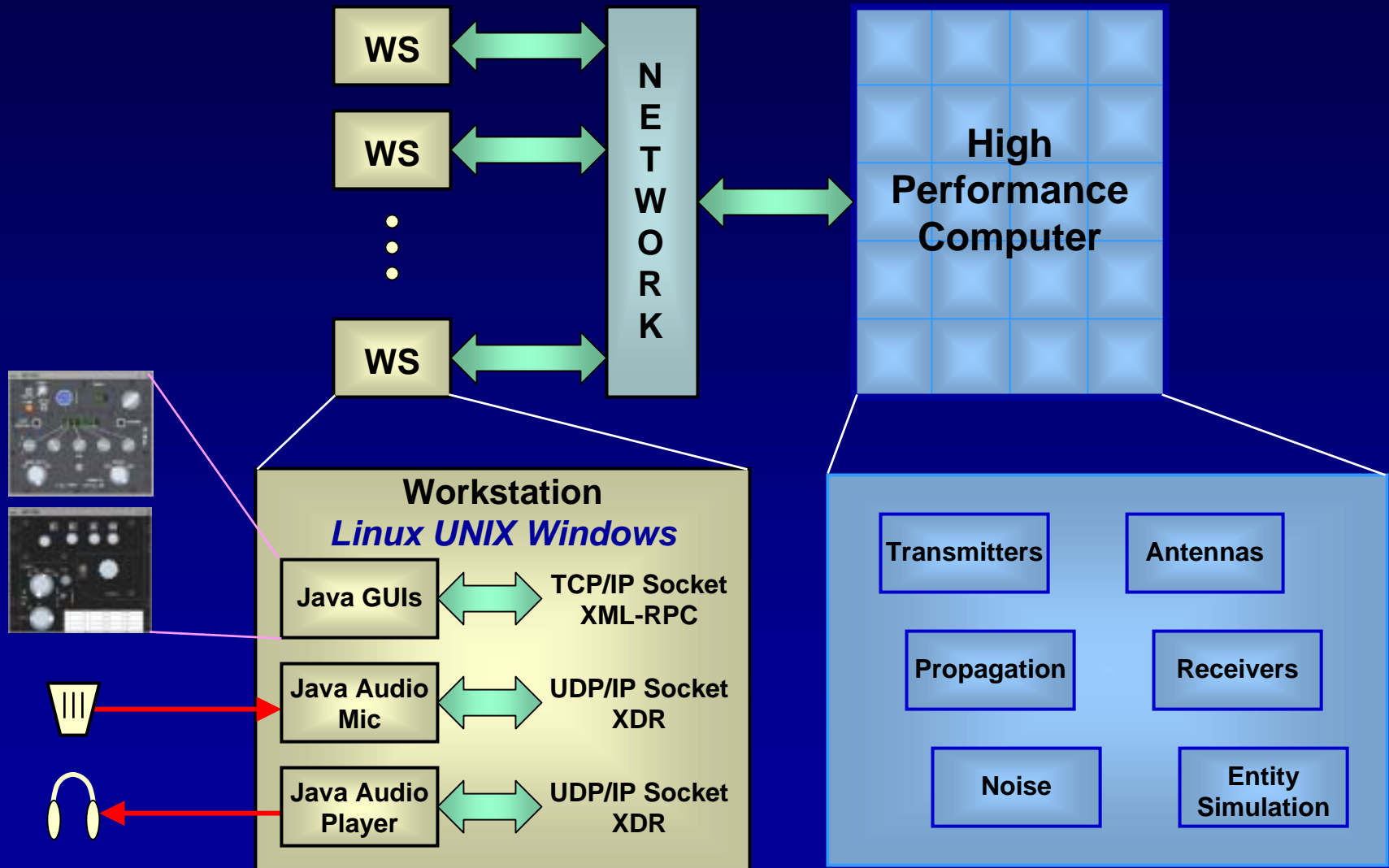


*Joint Distributed System-of-Systems Simulation (JDS<sup>3</sup>)*



# High Performance Computing for Physics

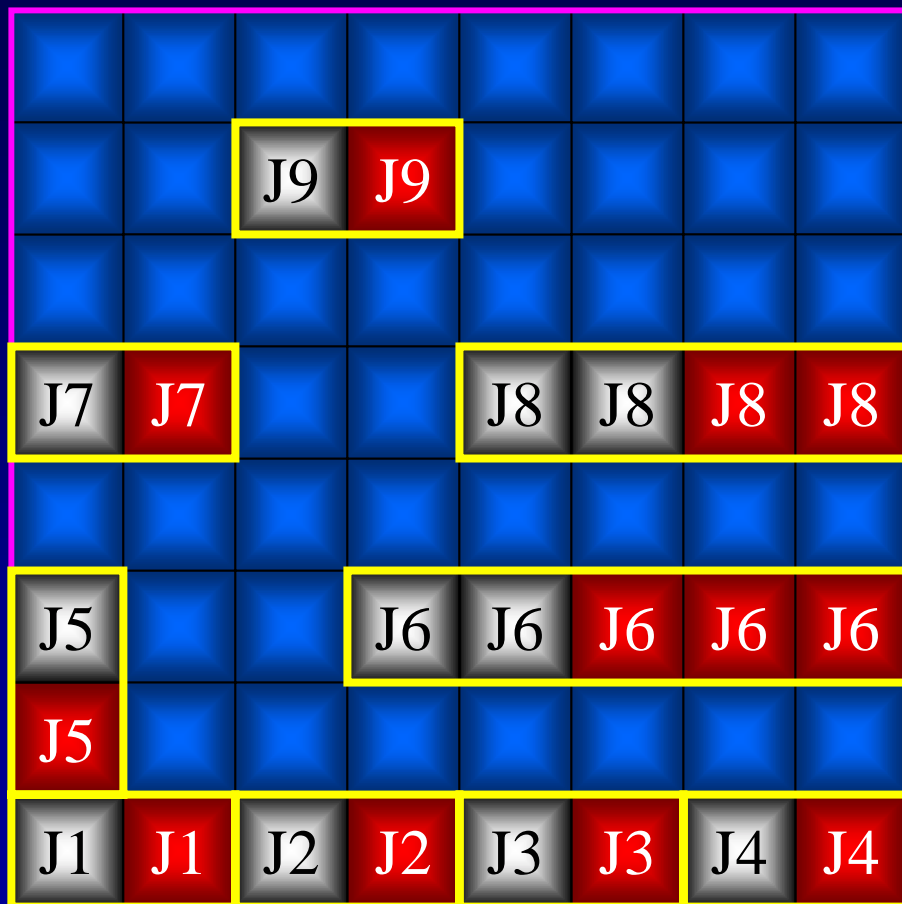
## Java User Interfaces for Portability



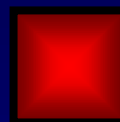
*Joint Distributed System-of-Systems Simulation (JDS³)*

# *Multiple Virtual JTRS Units*

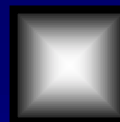
Implemented on a High Performance Computer



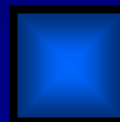
Legend:



JTRS Red Processor



JTRS Black Processor



Antenna, Propagation,  
Noise, Network, Entity  
Models ...

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# U.S. ARMY DEVELOPMENTAL TEST COMMAND

*Distributed Testing: Enabling the Future Force*



## YPG

- Air Drop
- Digital Terrain



## EPG/IEWTO

- Core Network
- Force Role Players
- Test Control
- Data Collection/Analysis
- IMASS



## DPG

- Simulated Chemical Threat
- Simulated Chemical Sensor
- Human Operator
- Weather



## WSMR

- TOC
- Inter-Range Control Center (IRCC)
- Live Fleet Wing



## ATC

- Robotic Intelligence
- Mobility Modeling



## RTTC

- Simulated IR Env
- IR Sensor Grid Platform
- Human Operators
- Live Sensors



## ATTC

- Simulated IR Env
- IR Sensor Air Vehicle
- Human Operator
- Enclosed Sensor

# ***JDS<sup>3</sup> Concept***

***Networked Communication Links Are the Foundation for Navy FORCEnet, Army Enterprise Architecture, and Air Force C2 Constellation***

**Use Networked Virtual Communication Links to Build, Test, Train, and Optimize These Systems With a Focus on Joint Interoperability**

**Implement Using High Performance Computing Modernization Program Assets**

**Apply Same Concept to Joint Distributed Engineering Plant (JDEP) to Test With Communication Links and Networks**

**Extend to Joint Tactical Radio System (JTRS), the Future of Interoperability, Functionality, and Interfaces**

**Connect to Test Ranges to Facilitate Hardware, Software, Systems, and Warfighter-in-the-Loop (TENA)**

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# ***Customers/Partners***

**PM JTRS (Cluster 1)**

**UGV/S JPO**

**PM FCS**

**PM JSF**

**PM JDEP**

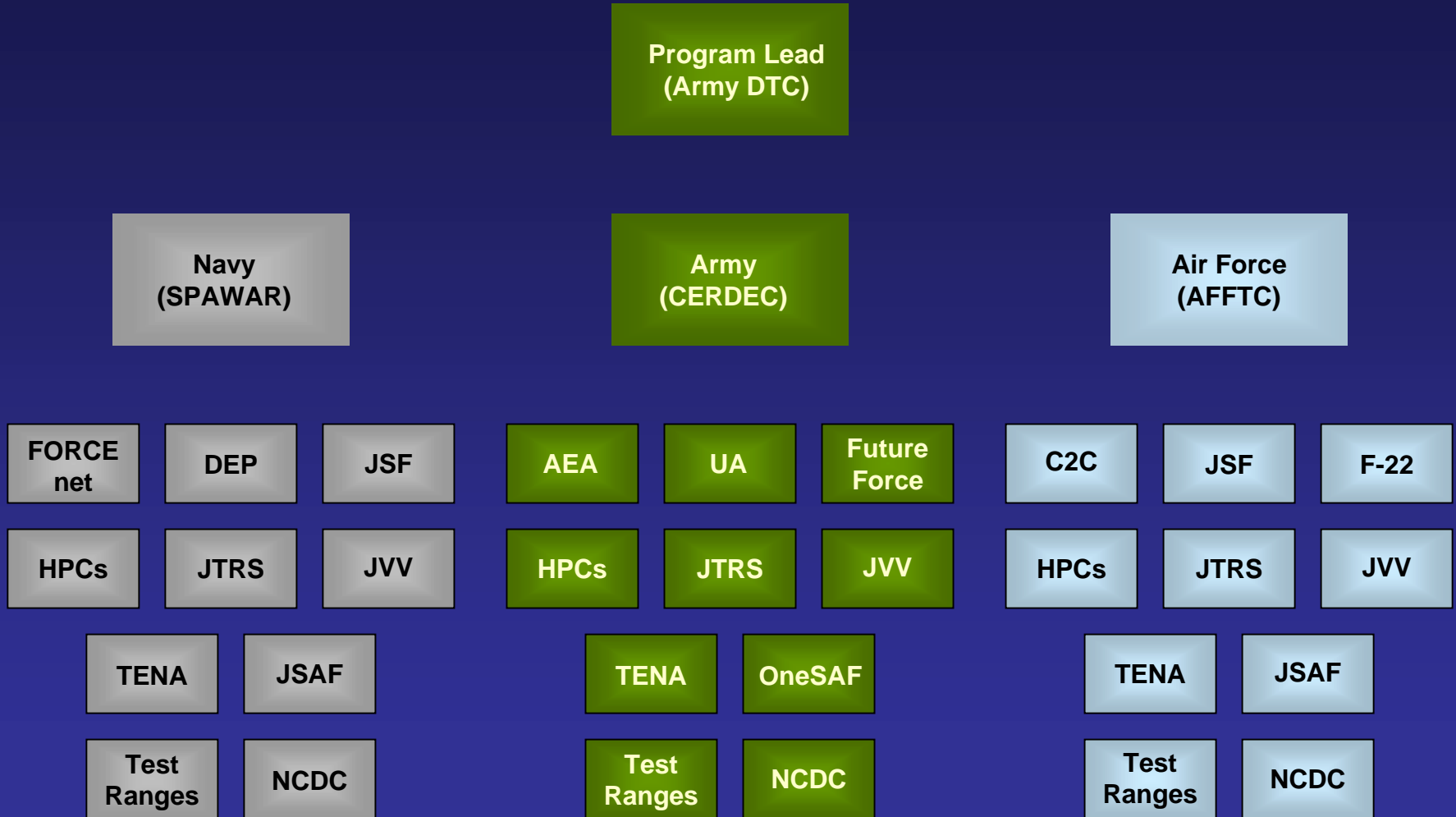
**JITC**

**Northrop Grumman (Integrated CNI Avionics  
Developer for JSF, F-22, AH-66)**

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# *JDS<sup>3</sup>*

## It All Plays Together



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